Continental Controls Tiny Buoy:
Evaluation at the Field Research Facility

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LONG-TERM GOALS AND OBJECTIVES

The goal of this study was to evaluate the performance of a small wave measuring buoy developed by Continental Controls & Design, Inc. The Tiny Wave Buoy (TWB) transmits directional wave spectra via an Iridium satellite link. The objective was to test the TWD at the Army Corps of Engineers Field Research Facility (USACE-FRF) in Duck, NC. This site provided the capability to deploy and retrieve the TWB and has a long history of making directional wave measurements and instrument testing as well as existing wave measuring infrastructure.

APPROACH

The FRF has a 15-element array of near-bottom pressure sensors in 8m depth approximately 800m offshore (8m array) from which high resolution directional wave measurements are made. The FRF also maintains and collects data from a Datawell directional Waverider buoy located in 17m depth water approximately 3km offshore. The TWB was planned to be deployed at both of these locations, making simultaneous measurements with the FRF gauges providing ground truth. Three or four deployments were desired with waves as large as possible where the TWB could be safely deployed and retrieved. The first deployments were planned to be tethered to a moored surface buoy in order to stay co-located with the comparison gauges. At least one deployment was to be free floating for evaluating the tether effect. Figure 1 shows the tethered TWB.

WORK COMPLETED

Two deployments were made. The first was located over the 8m array on 11 Jun 2008 when a 12 second swell was building in significant wave height from approximately 0.5 meter to 0.9 meter. The second deployment was at the seaward end of the FRF pier (nominal depth of 7 meters and about 590 meters offshore) during a storm that was too extreme for a ship deployment. Significant wave height exceeded 2.6 meters during the second test. Both deployments were made with the TWB tethered to an anchored surface

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14. ABSTRACT

The goal of this study was to evaluate the performance of a small wave measuring buoy developed by Continental Controls & Design, Inc. The Tiny Wave Buoy (TWB) transmits directional wave spectra via an Iridium satellite link. The objective was to test the TWD at the Army Corps of Engineers Field Research Facility (USACE-FRF) in Duck, NC. This site provided the capability to deploy and retrieve the TWB and has a long history of making directional wave measurements and instrument testing as well as existing wave measuring infrastructure.

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Figure 1. Tethered TWB during 11 Jun 2008 deployment

float with a 30 meter monofilament fishing line (300 pound test). Unfortunately, the tether line broke shortly into the second deployment and the TWB was not recovered. Data was received after the tether line broke and likely provided and assessment of free-floating characteristics.

RESULTS

The first deployment was 11 Jun 2008 lasted about six hours. The 8m array spectra are computed every 3 hours from a 2 hour 16 minute timeseries, whereas the TWB spectra update every 30 minutes. For this comparison consecutive TWB spectra were averaged for times overlapping the 8m array sampling. Three comparisons showed good comparison between the TWB and 8m array (Table 1 and Figure 2). Near-surface currents measured in the 8m array were about 0.3 m/s flowing southerly and winds were 7 m/s from the northeast.

Table 1. TWB and 8m array statistics for 11 Jun 2008

Time (UTC)	8m Hmo (m)	TWB Hmo (m)	8m Dir	TWB Dir
1305	0.46	0.53	72	115
1505	0.69	0.79	78	82
1805	0.79	0.83	72	89

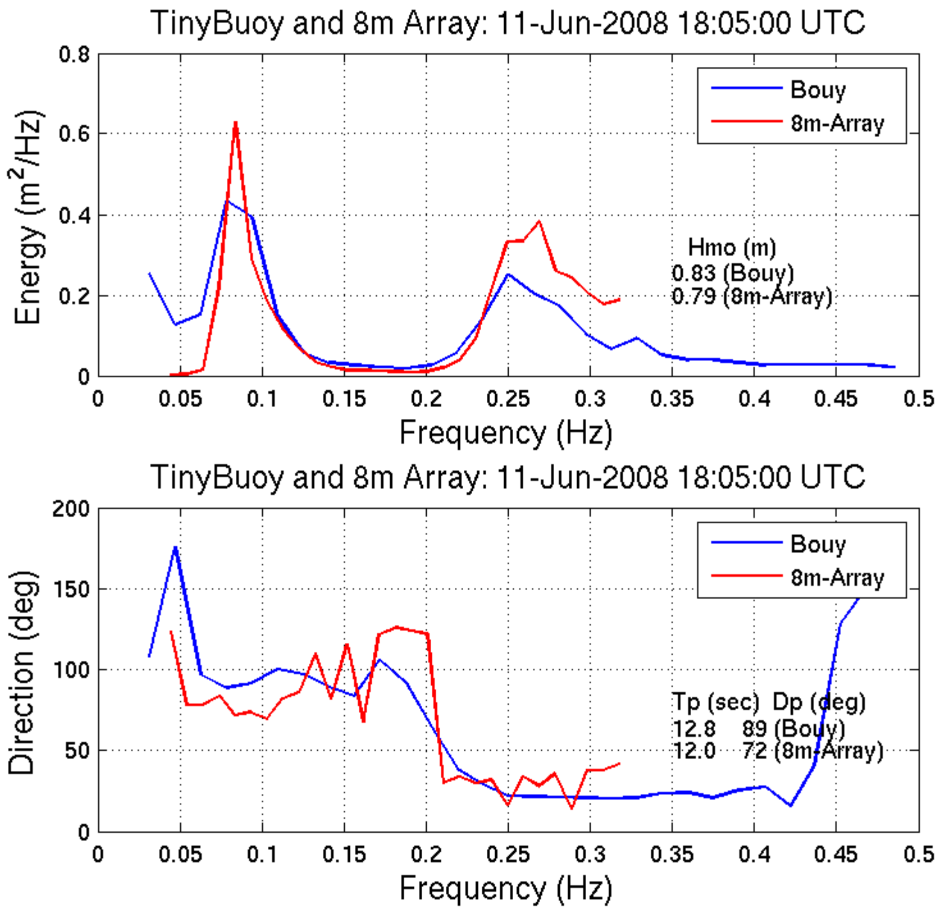

Figure 2. TWB and 8m array frequency and direction spectra on 11 Jun 2008.

The second deployment was made during a storm with significant wave height of 2.7 meters. Near-surface currents measured at approximately 300 meters north and the same cross-shore distance as the TWB were about 0.9 m/s flowing northerly and winds were 15 m/s from the south. Three spectra were obtained from the buoy before it stopped transmitting wave data . The first two spectra (1336 and 1438 UTC) were made when the buoy was tethered, both spectra show excessive low energy and overestime the wave height (Table 2, Figure 3). The lowest frequency bin (0.0469 Hz, 21 second period) of the TWB was dropped from the plots and wave height computation since the high energy levels at the low frequencies were not believable, probably an error due to tethering in strong currents. Averaging TWB spectra was not done since only three non-consecutive spectra were received. Direction spectra closely matched the 8m array over the energetic portion of the spectra.

Table 2. TWB and 8m array statistics for 6 Sep 2008

Time (UTC)	8m Hmo (m)	TWB Hmo (m)	8m Dir	TWB Dir
1336	2.69	2.98	92	65
1438	2.23	3.35	96	299
1541	2.23	2.03	96	108

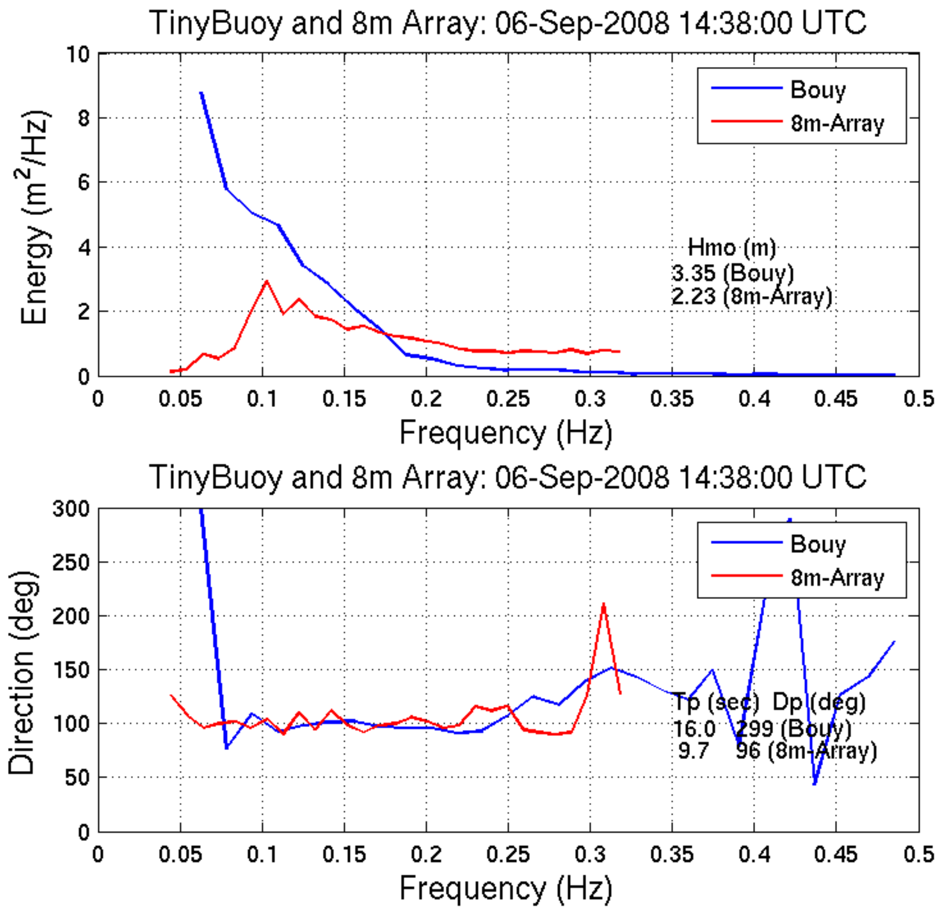

Figure 3. TWB (tethered) and 8m array frequency and direction spectra on 6 Sep 2008.

The third spectra (1541 UTC) was measured when the buoy was adrift, GPS location indicated it was about 4.5 km north (36.22433 N, 75.75715 W) of the FRF pier (36.1841 N, 75.74538 W) in a depth of 8 meters and 1 km from shore The energy spectra from the drifting TWB was more realistic and matched the 8m array better than when tethered. Frequencies below 0.0625 Hz (periods greater than 16 seconds) were ignored in this spectra since it also was over estimated. The directional spectra did not match the 8m array as well as when tethered. The reason for this discrepancy is not clear but possibly due to the instuments no longer being co-located, or that the spectra are not doppler corrected for the currents, or wave refraction.

We suspect an object floating in the strong current hit the TWB, breaking the tether and damaged the GPS unit. That may account for only receiving one spectrum while drifting. Overall the TWB preformed well but we recommend additional testing before considering the data to be research quality for models. Future versions should address the low-frequency amplification and improve data transmission. The size and ease of deployment of the TWB are attractive features.

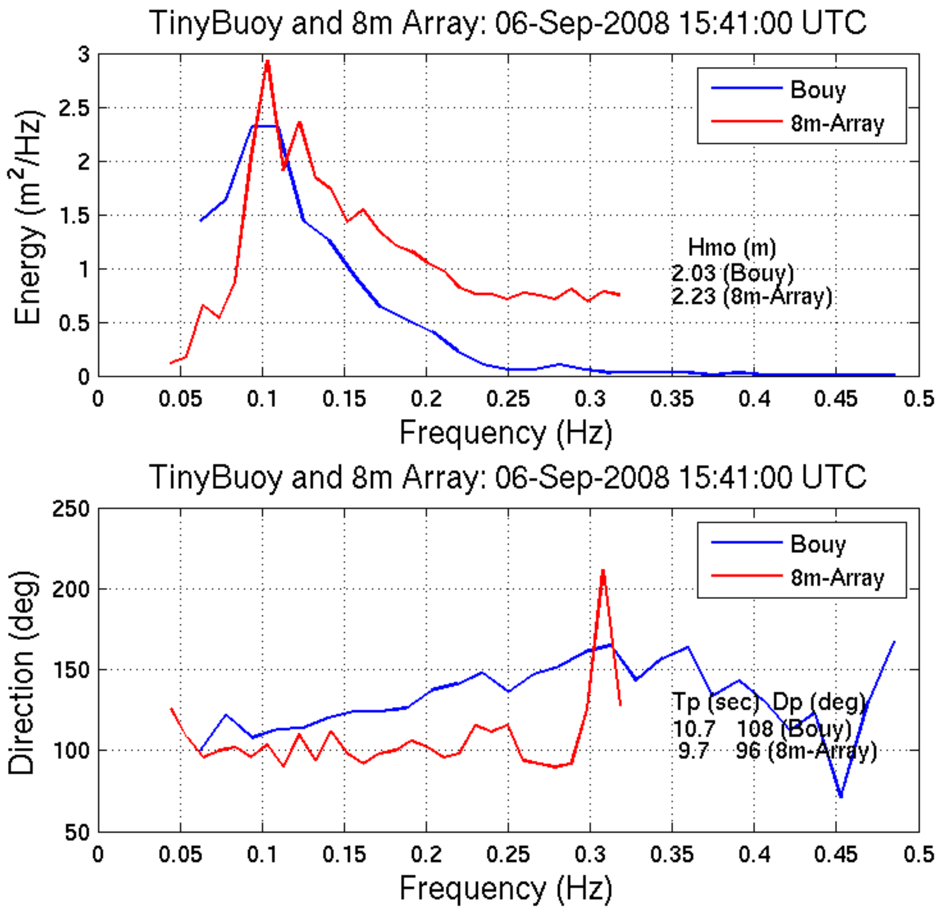

Figure 4. TWB (drifting) and 8m array frequency and direction spectra on 6 Sep 2008.

IMPACT/APPLICATIONS

The development of an inexpensive (~ $5k-$10k) directional wave buoy that is easily deployed, light weight, robust, and accurate would be of great value to coastal and ocean research. Such and instrument could be rapidly deployed in storm events or used in situations where a quick assessment of wave conditions are desired. The TWB could be an excellent research tool, and with Iridium transmission could be used worldwide

RELATED PROJECTS

None.